Chapter 5

Future Air Quality

Air quality modeling is an integral part of demonstrating future attainment of the clean air standards, relating emission reductions to air quality improvements. The 2016 AQMP reflects an updated emission inventory, economic growth projections, enhanced air quality modeling techniques, and the impacts of the proposed control strategies.

In This Chapter

Introduction

Air quality modeling to demonstrate future attainment of air quality standards is an integral part of the planning process to achieve clean air. Modeling provides the means to relate emission reductions from sources of pollution to the resulting air quality improvements. The attainment demonstrations provided in the 2016 AQMP reflect updated emissions estimates, new technical information, enhanced air quality modeling techniques, updated attainment demonstration methodology, and the control strategies provided in Chapter 4. While the primary target of the 2016 AQMP is to demonstrate progress toward the 2008 8-hour ozone standard of 75 ppb by 2031, efforts to meet other air quality standards and the corresponding analyses are included in the 2016 AQMP and presented in this chapter. Both the revoked 1997 8-hour standard (80 ppb) and the revoked 1979 1-hour standard (120 ppb) are included in the analysis with attainment years of 2023 and 2022, respectively. This chapter also demonstrates future attainment of the annual and 24-hour PM2.5 standards (12 and 35 μg/m^3).

The District's goal is to develop an attainment demonstration that: 1) ensures that ambient air quality standards for all criteria pollutants are met by the established deadlines in the federal CAA and 2) achieves an expeditious rate of progress towards attaining the air quality standards. The overall control strategy is designed such that efforts to achieve the standard for one criteria pollutant complements efforts to meet the standards for other pollutants.

Background

The South Coast Air Basin is classified as an "extreme" nonattainment area for ozone. The 2016 AQMP addresses three ozone standards: the 2008 8-hour standard of 75 ppb, the revoked 1997 8-hour standard of 80 ppb, and the revoked 1-hour standard of 120 ppb. The attainment deadline years are 2031, 2023 and 2022, respectively. The emissions inventory and meteorological conditions were developed for a 2012 base year.

The Basin is currently a "serious" nonattainment area for 24-hour PM2.5 and "moderate" nonattainment for annual PM2.5. The 2012 AQMP addressed attainment of the 2006 24-hour standard of 35 μg/m^3 by 2014; however, the unforeseen drought that occurred in the 2011–2014 time period inhibited the projected progress towards attainment. The District requested a voluntary bump-up from "moderate" status to "serious" nonattainment status in the "Supplement to the 24-Hour PM2.5 State Implementation Plan for the South Coast Air Basin" submitted to U.S. EPA in 2015 and subsequently approved in 2016. For "moderate" nonattainment areas, the attainment deadline was 2015 based on CAA *Title 1, Part D, Subpart 4, Section 188(c)(l),* which establishes that attainment must be reached by the end of the 6^{th} calendar year after the effective date of designation. The year 2019 is the new attainment deadline for "serious" nonattainment areas for the 24-hour PM2.5 standard.

The Basin was designated a "moderate" nonattainment area for the 2012 annual PM2.5 standard of 12 μg/m^3 on April 15, 2015. This designation sets an attainment deadline of December 31, 2021. Despite the recent drought, the Basin shows continued improvement in annual PM2.5 design values. The base year annual PM2.5 design values at Mira Loma are lower than the previous 1997 standard of 15 µg/m^3, but do not yet meet the new 2012 standard of 12 µg/m^3 (Figure 5-11), indicating that additional reductions may be needed to meet the more stringent standard. Acknowledging the challenges in meeting the standard, including the feasibility of proposed measures, uncertainties in drought conditions, and the potential inability to credit all ozone strategy reductions towards PM2.5 attainment if approved under CAA Section 182(e)(5), SCAQMD will request a voluntary bump-up to the “serious” classification, with a new attainment date of 2025. Future year attainment was analyzed for 2021, the original target for “moderate” nonattainment, and 2025, the revised attainment date for the requested “serious” status. This AQMP includes all the milestone years significant to future PM2.5 attainment status: 2019 (24-hour PM2.5 attainment date), 2021 (annual PM2.5 attainment date for “moderate” nonattainment status) and 2025 (annual PM2.5 attainment date for “serious” nonattainment status). In addition, 2023 was included in the analysis to evaluate co-benefits of the ozone strategy on PM attainment and to assess the practicability of an earlier PM2.5 attainment date.

During the development of the 2012 AQMP, the District implemented an air quality modeling platform that integrates meteorological modeling, emissions inventories and atmospheric chemistry simulations into a physically and chemically consistent framework. In the 2007 and earlier AQMPs, the modeling platforms for meteorology and chemical-transport were developed separately. In addition, ozone and PM2.5 used separate modeling approaches due to the limitations of computational capacity. Recent advancements in computational technology enabled the transition to a state-of-science one-atmosphere, multi-pollutant modeling platform.

For the 2016 AQMP, the updated modeling platform has continued to serve as the primary tool to demonstrate attainment after incorporating the latest datasets and chemical mechanisms. Since completion of the 2012 AQMP, the modeling platform has been updated with satellite-based input data, improved chemical gaseous and particulate mechanisms, improved computational resources and post-processing utilities, enhanced spatial and temporal allocations of the emissions inventory, and a revised attainment demonstration methodology. Several other additional updates were also included.

The 2016 AQMP ozone and PM2.5 attainment demonstration has been developed using the U.S. EPA-supported Community Multiscale Air Quality (CMAQ) (version 5.0.2) modeling platform with Statewide Air Pollution Research Center (SAPRC) 07 chemistry, and the Weather Research and Forecasting Model (WRF) (version 3.6.1) meteorological fields. PM2.5 and ozone were modeled simultaneously using the one-atmosphere modeling platform. Ozone attainment demonstrations focused on the period from May through September, while PM2.5 was analyzed for the entire year. The simulations were conducted over an area with a western boundary over 100 miles west of the Ports of Los Angeles and Long Beach. The eastern boundary extends slightly beyond the Colorado River while the northern and southern boundaries of the domain extend to the San Joaquin Valley and the Northern portions of Mexico, respectively. CMAQ was simulated with a 4-kilometer grid resolution.

For the 2016 AQMP, WRF was updated with the most recent version (version 3.6.1) available at the time of protocol preparation and was evaluated with a set of input data, which includes land-use classification and sea-surface temperature initialization fields. The WRF simulations were initialized from National Centers for Environmental Prediction (NCEP) analyses and run for three-day increments with four-dimensional data assimilation (FDDA).

Day-specific point source emissions were extracted from the District's stationary source and RECLAIM inventories. Mobile source emissions included day and hour real-time profiles based on the CALTRANS Performance Measurement System and weight-in-motion profiles, CARB's EMFAC2014 emissions model, and vehicle population data and transportation analysis zone (TAZ) data provided by SCAG. The mobile source data and selected area source data were subjected to daily WRF-derived temperature corrections to account for enhanced evaporative emissions on warmer days. Gridded daily biogenic VOC emissions were provided by CARB using the MEGAN biogenic emissions model. The simulations benefited from enhancements made to the emissions inventory, such as day-specific adjustments in traffic volumes when generating on-road emissions and improvements in gridding surrogates for spatial allocations of area and off-road emissions.

Detailed information on the modeling approach, data retrieval, model development and enhancement, model application, emissions inventory development, and interpretation of results is presented in Appendix V. The following sections summarize the results of the 8-hour/1-hour ozone and annual/24-hour PM2.5 attainment demonstration modeling efforts and provide an update to the future projected ozone and PM2.5 levels given new emissions estimates, the latest air quality measurements, and modeling tools.

Ozone Modeling Approach

Design Values and Relative Response Factors (RRF)

To bridge the gap between air quality model predictions and measurements, U.S. EPA guidance has recommended the use of relative response factors (RRFs). In this approach, future year concentration predictions require two elements: base year design values and RRFs. The RRF is simply a ratio of the future year predicted air quality to the simulated air quality in the base year, representing the model-predicted change in air quality in response to predicted emissions changes. The attainment demonstrations are pollutant and averaging period specific. Base-year design values for 2012 were obtained from measurements and correspond to the form of the NAAQS. Eight-hour design values are calculated from the 3-year average of the fourth highest daily ozone 8-hour average concentration in each year. The 1-hour ozone design value represents the fourth highest 1-hour ozone value in a three-year period. Base year design values for the attainment demonstration are calculated as a five-year weighted average (average of the three, 3-year design values centered at the base year, 2012). Future year concentrations are estimated by multiplying the non-dimensional RRF by the base year design value, thus applying the model-predicted change in air quality directly to the actual measured concentrations in the base year. Assuming any potential modeling biases are similar in the base and future years, the RRF approach acts to minimize their impact on predictions.

Design Value Selection

U.S. EPA guidance recommends the use of multiple year averages of design values, where appropriate, to dampen the effects of single year anomalies in the air quality trend due to factors such as adverse or favorable meteorology or radical changes in the local emissions profile. The trend of Basin ozone design values is presented in Figure 5-1. Both 8-hour and 1-hour ozone design values have decreased over the

14-year period. The most recent 8-hour design value (102 ppb) continues to exceed the 1997 8-hour ozone standard (80 ppb) by 28 percent and the 2008 ozone standard (75 ppb) by 36 percent. In addition, the most recent 1-hour design value of 135 ppb exceeds the 1979 1-hour ozone standard (120 ppb) by 13 percent.

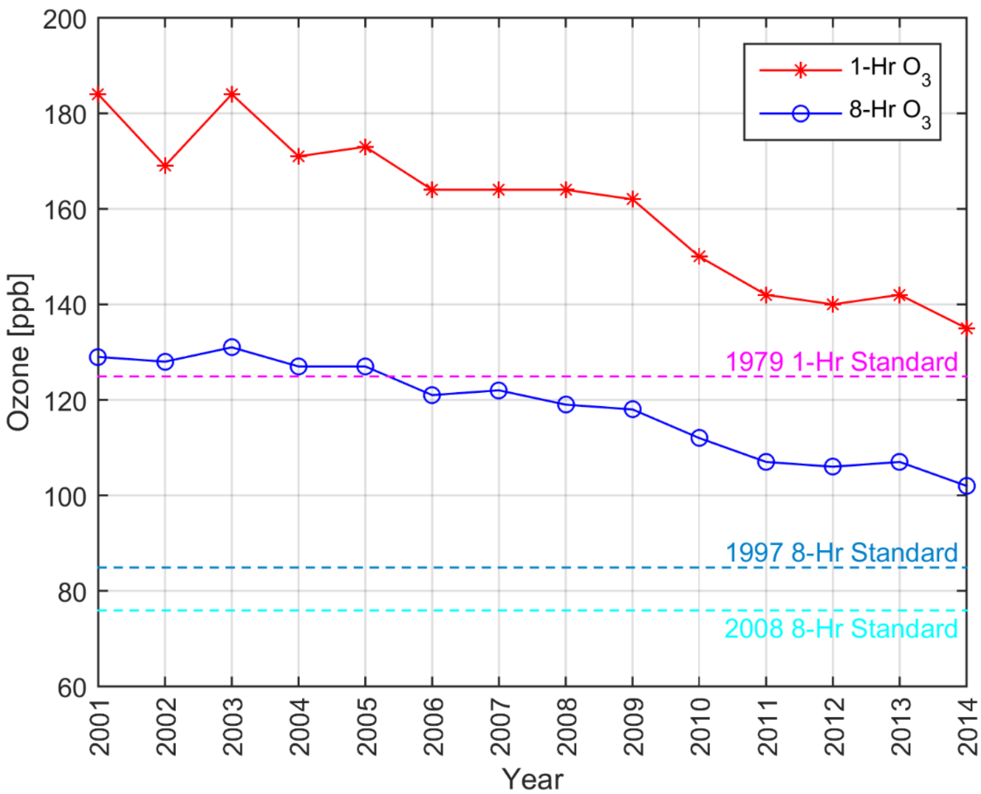

FIGURE 5-1

SOUTH COAST AIR BASIN OZONE DESIGN VALUES. EACH 8-HOUR VALUE REPRESENTS THE 3-YEAR AVERAGE OF THE YEARLY FOURTH HIGHEST 8-HOUR AVERAGE OZONE CONCENTRATION. THE 1-HOUR VALUES REPRESENT THE FOURTH HIGHEST 1-HOUR OZONE OVER A 3-YEAR PERIOD

The 2016 AQMP attainment demonstrations rely on air quality measurements collected during the five-year period centered on 2012, which is the base year selected for the emissions inventory development, the WRF meteorological simulation, and the anchor year for the future year ozone and PM2.5 projections.

Ozone Representativeness

Past ozone attainment demonstrations, up to and including the 2007 AQMP, evaluated a set of meteorological conditions conducive for air pollutant build-up or evaluated episodes occurring during concurrent intensive field monitoring programs. These episodic periods were rated based on how representative they were in reference to the ozone standard being evaluated. The 2007 AQMP was the first plan to address the 8-hour ozone standard and use RRFs in the future year ozone projections. To provide a robust characterization of the RRFs for use in the attainment demonstration, the analysis simulated a total of 36 days. The ozone modeling guidance used for the 2007 AQMP recommended that a minimum of five days of simulations meeting modeling acceptance criteria be used in a future year RRF calculation, but recommended incorporating as many days as possible to fully capture both the meteorological variations in the ozone season and the response of ozone formation for different daily emissions profiles.

The 2012 AQMP used a different approach. Instead of the episode-based simulation days, it included season-long (June through August) comprehensive CMAQ simulations. It analyzed 92 simulation days and chose the days that met the following selection criteria: the predicted daily max is within 20 percent of the site-specific design value, the unpaired daily maximum prediction error is less than 20 percent, and the prediction is higher than the federal standard of 75 ppb. The maximum modelled grid cell in the 3 by 3 grid centered at each station was retrieved from the base and future year simulations. The number of days used in the RRF calculation differed from station to station. Approximately 50 days met the criteria at Crestline, more than half of the entire simulation period.

The approach used in the current AQMP is similar to the approach used in the 2012 AQMP with the following changes per recent U.S. EPA guidance (U.S. EPA, 2014).[1] The ozone season was expanded from May to September (153 simulation days) in order to capture exceedances that occurred in early and late summer. Only the top 10 days are used to calculate the RRF. Some stations have fewer than 10 days meeting the specified criteria with daily maximum 8-hr values exceeding 60 ppb and the unpaired daily-max prediction error less than 20 percent. These stations are included in the analysis as long as five or more days meet the selection criteria. The maximum modeled value in the 3 by 3 grid surrounding each station is compared to the corresponding grid position in the future year. A similar approach was implemented for the 1-hour ozone future year projections; details of the 1-hour ozone and 8-hour ozone analysis are presented in Appendix 5.

Basin-wide ozone air quality simulations were conducted for each hour in the 2012 ozone season (May 1st to September 30th). Figure 5-2 depicts the observed daily maximum 8-hour ozone levels Basin-wide and at Crestline and Redlands during the 2012 ozone season. Crestline was the design value site in the past, but Redlands showed the highest design value for the five-year period in the current analysis. During this period, several well-defined multi-day ozone episodes occurred in the Basin, with 107 total days having daily maximum concentrations of 75 ppb or higher. Stations located in San Bernardino and Riverside counties show similar levels of elevated ozone as Crestline and Redlands, exhibiting the influences of similar transport and chemistry patterns.

[1] https://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

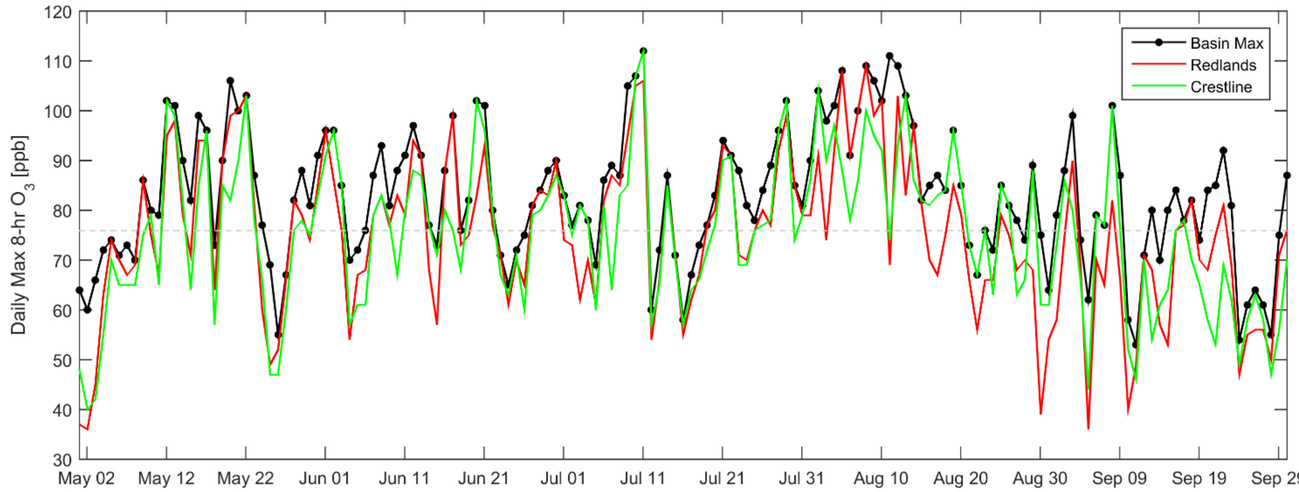

FIGURE 5-2

OBSERVED BASIN, REDLANDS, AND CRESTLINE DAILY MAXIMUM 8-HOUR AVERAGE OZONE CONCENTRATIONS: MAY 1 THROUGH SEPT 30, 2012.

Table 5-1 lists the number of weekend and weekday days exceeding the 8-hour ozone standard during the 2012 ozone season for stations that meet the U.S. EPA's data completeness requirement and have design values greater than 75 ppb. A "weekend effect," typically experienced in urban areas, results from reduced NOx emissions on weekends leading to higher ozone and consequently more weekend days exceeding the standard. This indicates a benefit of VOC reductions from concurrent reductions from the NOx control strategy or stand-alone VOC controls such as the consumer products program—to minimize inadvertent ozone increases during the course of NOx reduction.

TABLE 5-1

Five-year Weighted Design Values and Number of Days Daily Maximum Concentrations Exceeded 75 ppb in 2012

Station*	2012 5-Year Weighted Design Value (ppb)	Number Of Weekend Days In 2012 With Observed daily max 8-hour Ozone > 75 ppb	Number Of Weekday Days In 2012 With Observed daily max 8-hour Ozone > 75 ppb
Azusa	79.3	9	2
Banning	95.3	21	45
Crestline	103.0	30	59
Fontana	101.0	35	30
Glendora	92.7	29	18
Lake Elsinore	85.3	6	11
Mira Loma	92.7	24	29
Perris	91.0	17	32
Pomona	84.3	12	5
Redlands	104.7	35	50
Reseda	89.0	11	17
Rubidoux	96.3	24	29
San Bernardino	98.0	29	28
Santa Clarita	97.3	30	32
Upland	96.7	25	24

**Stations having design values greater than 75 ppb and meeting data completeness criteria*

Ozone Modeling Approach

The set of 153 days from May 1st through September 30th, 2012 were analyzed to determine the 8-hour maximum ozone for the base (2012) and future attainment years 2023 and 2031—the attainment years for the 1997 standard of 80 ppb and the 2008 standard of 75 ppb, respectively. Both baseline and controlled cases were simulated. The former represents the level of emissions with no additional reductions beyond existing measures, and the latter contains additional emission reductions proposed in the 2016 AQMP to reach attainment.

Finally, a set of simulations with incremental VOC and NOx emission reductions from 2023 and 2031 baseline emissions were generated to create ozone isopleths for each station in the Basin. The ozone isopleths provide guidance in developing control strategies by depicting ozone concentrations as a function of both NOx and VOC reductions. They provide the basis for estimating the Basin carrying capacity, the maximum allowable emissions of NOx and VOC to reach attainment.

Future Ozone Air Quality

The 2016 AQMP baseline ozone simulations reflect the changes made to the 2023 and 2031 baseline inventories. The 2016 AQMP summer planning inventory for 2023 has a similar VOC/NOx emissions ratio (1.35 vs. 1.37) as the 2012 AQMP, although total tonnages of both precursor emissions are lower than those presented in the 2012 AQMP. Lower 2023 baseline VOC and NOx emissions in the 2016 AQMP relative to the 2012 AQMP reflect the impact of rules and regulations implemented after the 2012 AQMP as well as the recession occurring between 2008 and 2010. The 2012 AQMP relied on the 2012 Regional Transportation Plan (RTP) to forecast future growth. To a certain degree, the 2012 RTP incorporated the impact of the economic recession that occurred during the 2008–2010 period. But, it is unlikely that this growth forecast reflected the full intensity of the recession. For example, the consumption of taxable gasoline consumption reached its minimum level in 2012, which is after the RTP was finalized in April 2012. Therefore, some discrepancies are expected between the projected emissions inventory for 2012 and the 2012 actual emissions data. The new 2016 AQMP inventory is revised to properly account for this impact.

8-Hour Ozone Attainment

The 2016 AQMP addresses both the revoked 1997 8-hour ozone standard of 80 ppb and the 2008 8-hour ozone standard of 75 ppb, for which attainment dates are 2023 and 2031, respectively. Table 5-2 summarizes the results of the updated ozone simulations. The 2023 ozone baseline and 2023 controlled ozone projections from the 2012 AQMP are included in the table for comparison. The 2012 AQMP concluded that NOx emissions must be reduced by 65 percent of baseline emissions to meet the 80 ppb standard by 2023.

TABLE 5-2

Model-Predicted 8-Hour Ozone Concentrations (ppb)

Station	Final 2012 AQMP		2016 AQMP			
	2023 Baseline	2023 Controlled	2023 Baseline	2023 Controlled	2031 Baseline	2031 Controlled
Azusa	95	77	77	70	75	62
Banning	94	73	89	78	85	71
Crestline	107	81	93	81	89	72
Fontana	104	81	96	84	92	75
Glendora	107	84	93	83	90	74
Lake Elsinore	85	66	74	65	70	58
Perris	88	66	80	70	76	62
Pomona	100	80	83	75	81	67
Redlands	103	77	95	82	90	73
Reseda	90	73	79	71	75	64
Riverside	100	77	89	78	86	69
San Bernardino	108	83	90	78	86	70
Santa Clarita	94	73	84	76	80	68
Upland	106	83	92	82	89	73

Both 2023 and 2031 baseline scenarios that do not contain additional reductions beyond already adopted measures do not lead to attainment, indicating additional emission reductions are necessary to meet the standards. The carrying capacities, the maximum allowable NOx emissions to meet ozone standards, are estimated to be 141 TPD NOx in 2023, and 96 TPD NOx in 2031. These are equivalent to an additional 45 percent and 55 percent of NOx reductions, respectively, from the 2023 and 2031 baseline emission levels. These reductions will ensure attainment of the federal 8-hour standard by 2023 and the 2008 standard by 2031 at all stations.

The proposed needed reductions are significantly less than the estimates presented in the 2007 and 2012 AQMPs. Several factors contributed to this change. First, the 2012 base year design values are lower than the 2005 and 2008 base year design values used in the 2007 AQMP and the 2012 AQMP, respectively, due to the improvements in air quality with time, indicating greater than expected efficacy of control strategies implemented in the Basin. Secondly, improvements introduced to the emissions inventory led to better estimates of 2023 emissions. 2023 baseline emissions were revised significantly in the 2012 AQMP from the 2007 AQMP due to emission changes in the on-road truck and off-road equipment categories resulting from CARB rulemaking. The 2023 baseline emission projections were further revised in the 2016 AQMP. The revised 2023 baseline shows 255 TPD of total NOx emissions compared to the 319 TPD projected in the 2012 AQMP and the 506 TPD projected in the 2007 AQMP. The lower baseline emissions reflect the impact of rules and regulations implemented after the release of the previous AQMPs. Also, while the recession that occurred during the 2008 to 2010 period was incorporated in the 2012 AQMP inventory, its impact was further refined in the 2016 AQMP, resulting in lower 2023 emissions than what was originally predicted in the 2012 AQMP. Methodological updates to emissions estimates contributed to the changes as well. For example, the allocation of LPG consumption data for the Basin compared to the State was reduced by approximately 50 percent based on the most recent data from the State's GHG reporting system. The lower NOx emissions baseline leads to a lower percentage of needed reductions. Thirdly, the new attainment demonstration focuses only on top 10 concentration days, as discussed previously. The RRF approach used in the 2012 AQMP, based on U.S. EPA guidance available at the time, included more than 60 days, approximately two thirds of the total simulation days. According to U.S. EPA, the approach using the top 10 days yields a slightly better estimate of the actual observed ozone change than the previous approach of focusing on the days most likely to exceed the standard.

Spatial Projections of 8-Hour Ozone Design Values

The spatial distribution of ozone design values for the 2012 base year is shown in Figure 5-3. Projected 8-hour ozone design values for 2023 and 2031 with and without implementation of all proposed control measures are presented in Figures 5-4 through 5-7. The predicted ozone concentrations will be significantly reduced in future years in all parts of the Basin with the control measures proposed in the 2016 AQMP. Future design values are predicted from modeled RRFs and base-year design values. Future design values are then interpolated to cover the areas between monitoring stations using a natural neighbor interpolation, the interpolation scheme that best represents the Basin. Refer to Appendix V for details.

Appendix V also provides base year model performance statistics and grid-level CMAQ predictions for the base and future milestone years as well as a weight of evidence discussion to support the modeling attainment demonstration.

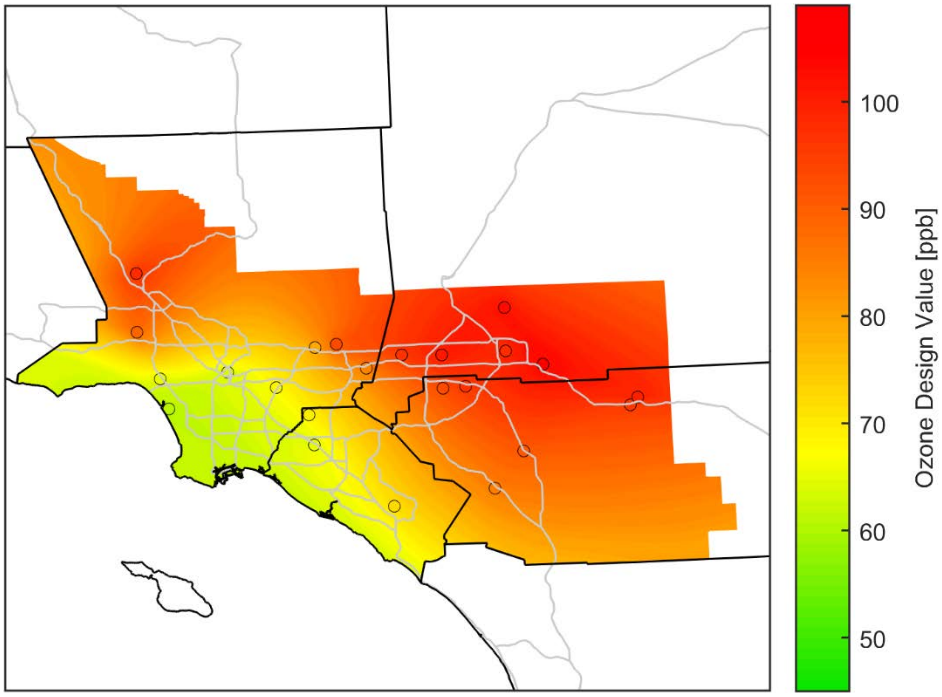

FIGURE 5-3

INTERPOLATED 5-YEAR WEIGHTED 8-HOUR OZONE DESIGN VALUES (ppb) FOR 2012. VALUES ARE COLOR-CODED TO CORRESPOND TO THE 2008 75 ppb AIR QUALITY INDEX

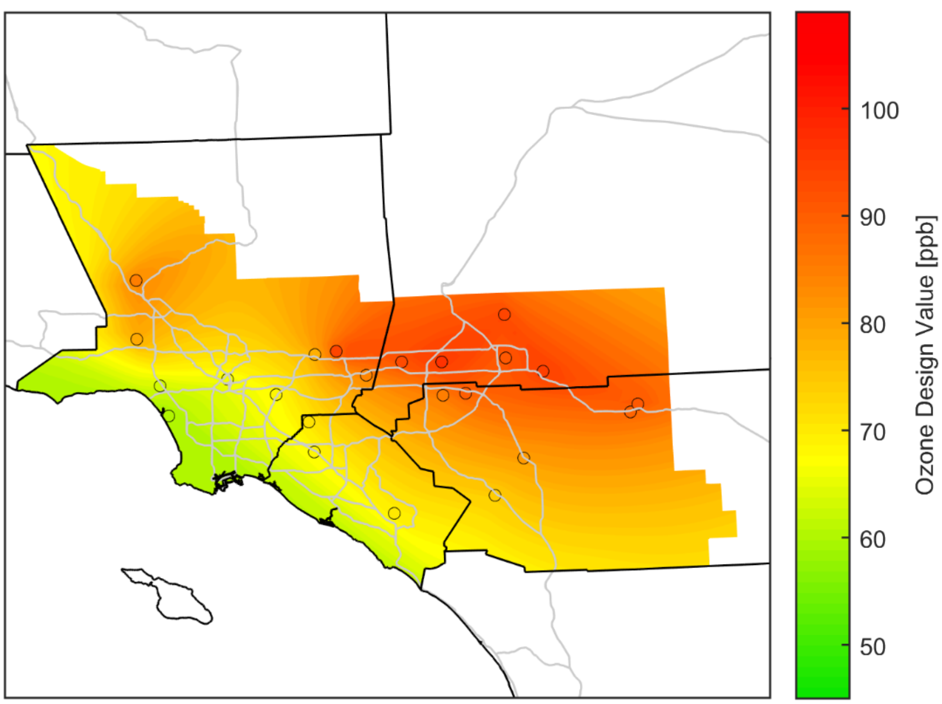

FIGURE 5-4

INTERPOLATED 2023 BASELINE 8-HOUR OZONE CONCENTRATIONS (ppb). VALUES ARE COLOR-CODED TO CORRESPOND TO THE 2008 75 ppb AIR QUALITY INDEX

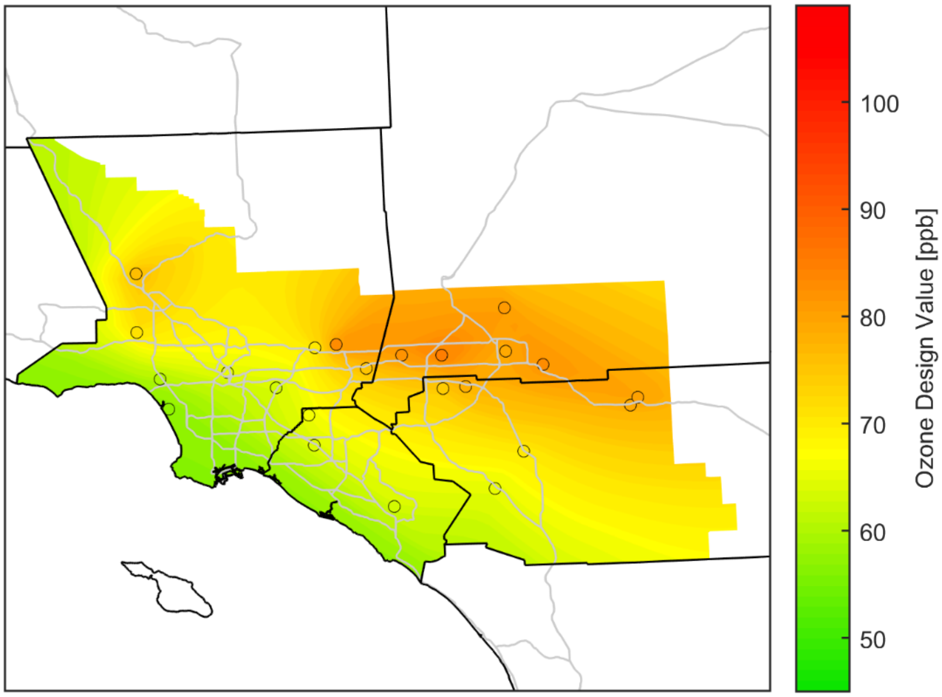

FIGURE 5-5

INTERPOLATED 2023 CONTROLLED 8-HOUR OZONE CONCENTRATIONS (ppb). VALUES ARE COLOR-CODED TO CORRESPOND TO THE 2008 75 ppb AIR QUALITY INDEX

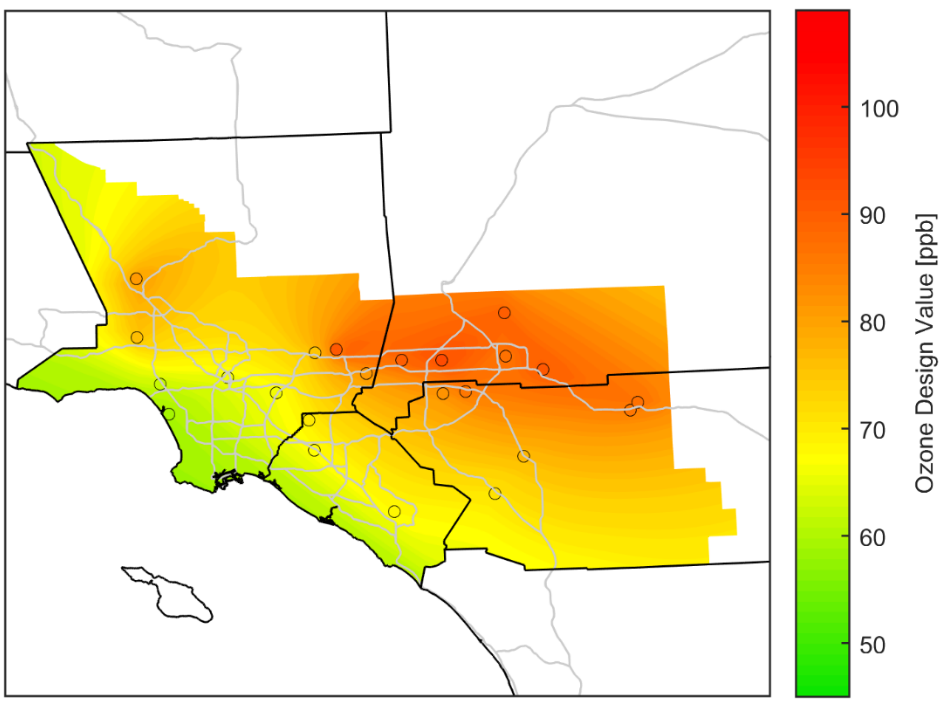

FIGURE 5-6

INTERPOLATED 2031 BASELINE 8-HOUR OZONE CONCENTRATIONS (ppb). VALUES ARE COLOR-CODED TO CORRESPOND TO THE 2008 75 ppb AIR QUALITY INDEX

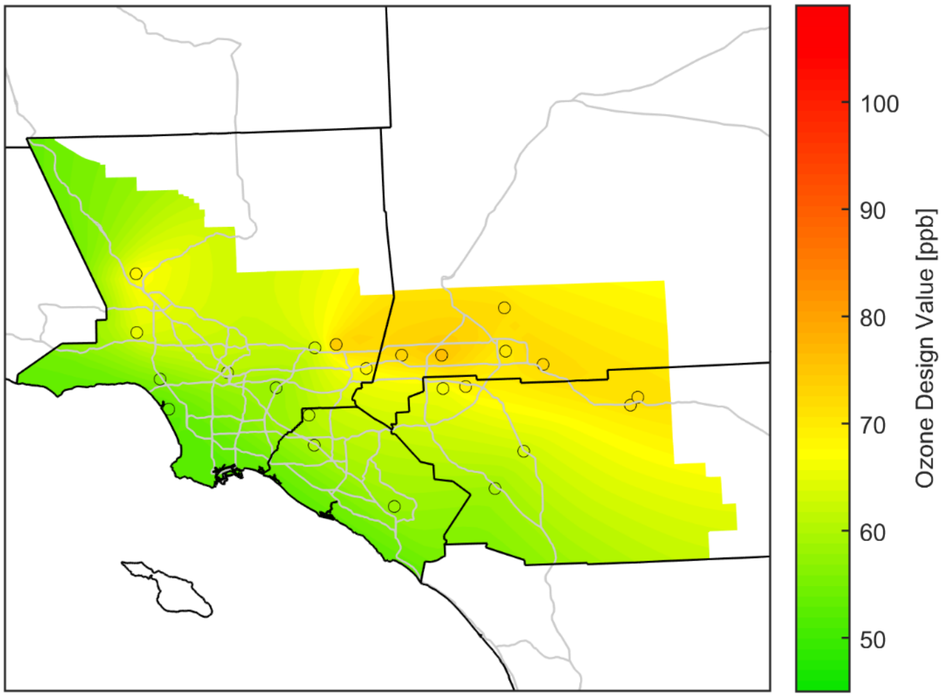

FIGURE 5-7

INTERPOLATED 2031 CONTROLLED 8-HOUR OZONE CONCENTRATIONS (ppb). VALUES ARE COLOR-CODED TO CORRESPOND TO THE 2008 75 ppb AIR QUALITY INDEX

1-Hour Ozone Attainment

The 2016 AQMP also addresses the 1979 1-hour ozone standard of 120 ppb with an attainment date of 2022. Table 5-3 summarizes the results of the updated ozone simulations. The 2012 AQMP projected baseline and controlled design values using a RRF analysis are also included for comparison. The 2022 baseline scenario with no additional reductions beyond already adopted measures does not lead to attainment, indicating that additional emission reductions are necessary to meet the standards. The carrying capacity to attain the 1-hour standard is approximately 245 TPD of NOx, indicating the need to reduce NOx emission by approximately 50 TPD. However, unlike 8-hour ozone which responds to NOx reductions much more than VOC reductions, 1-hour ozone responds to VOC reductions as sensitively as NOx reductions. Therefore, VOC reductions are as effective as NOx reduction in attaining the 1-hour standard. Consequently, the 1-hour ozone standard can be attained with a combined approximate 50 TPD reduction of either NOx or VOC emissions. The attainment scenario presented in the following table and figures were conducted with 33 TPD of NOx emissions reduction and 16 TPD of concurrent VOC reductions that are expected to occur from the NOx strategy. Note that the emission reductions for the 1-hour ozone strategy are a part of the 8-hour ozone strategy, but were identified to be feasible for early implementation. The control strategies to meet the 80 ppb 8-hour standard in 2023 are expected to achieve reductions necessary to meet the 1-hour standard in 2022.

TABLE 5-3

Base-year Design Values and Model-Predicted 1-Hour Ozone Design Values (ppb)

Station	2012 5-Year Weighted Design Value	Final 2012 AQMP		2016 AQMP	
		2022 Baseline	2022 Controlled	2022 Baseline	2022 Controlled
Azusa	112	139	131	104	101
Banning	-	119	102	--	--
Burbank	-	123	111	--	--
Crestline	132	134	116	120	118
Fontana	138	128	110	125	122
Glendora	132	143	133	121	119
Lake Elsinore	108	108	90	93	91
Pasadena	-	141	134	--	--
Perris	114	111	94	108	106
Pomona	117	124	108	103	101
Redlands	133	127	109	120	118
Reseda	125	112	101	105	103
Riverside	124	116	103	109	106
San Bernardino	123	127	110	107	104
Santa Clarita	132	119	105	110	108
Upland	135	135	121	122	119

NOTE: Burbank, Pasadena, and Banning do not have 5-year weighted 2012 base-year design values due to incomplete measurement data, and therefore, it was not possible to calculate 2022 design values at these stations. Burbank does not meet U.S. EPA data completeness requirements in 2014, Pasadena does not meet U.S. EPA data completeness requirements in 2013, and Banning does not meet U.S. EPA data completeness requirements in 2013.

With proposed controls in place, the analysis demonstrates that all stations in the Basin will meet the 1979 federal 1-hour ozone standard by 2022. The proposed reduction percentage and the carrying capacity are lower than the estimates presented in the 2012 AQMP due to the same reasons discussed previously for the 8-hour ozone modeling.

Spatial Projections of 1-Hour Ozone Design Values

The spatial distribution of 1-Hour ozone design values for the 2012 base year is shown in Figure 5-8. Future year ozone air quality projections for 2022 with and without implementation of all proposed control measures are presented in Figures 5-9 through 5-10. The predicted ozone concentrations will be significantly reduced in the future years in all parts of the Basin with the control measures proposed in the 2016 AQMP. Future design values are predicted from modeled RRFs and measured base-year design values. Future design values are then interpolated using a natural neighbor interpolation to generate the interpolated fields.

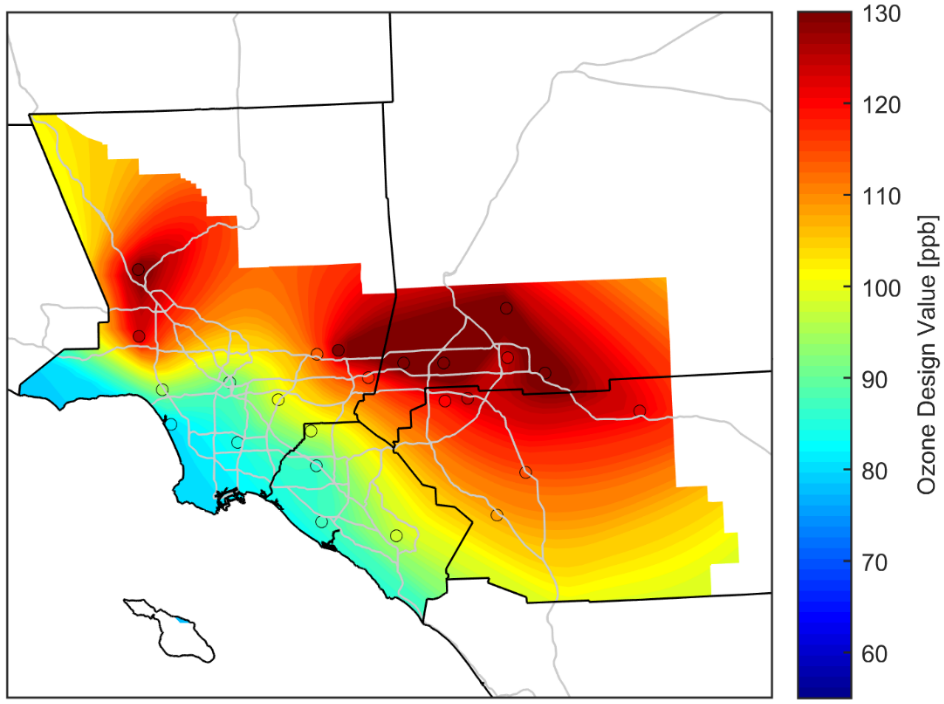

FIGURE 5-8
2012 OBSERVED 5-YEAR WEIGHTED 1-HOUR OZONE DESIGN VALUES (ppb)

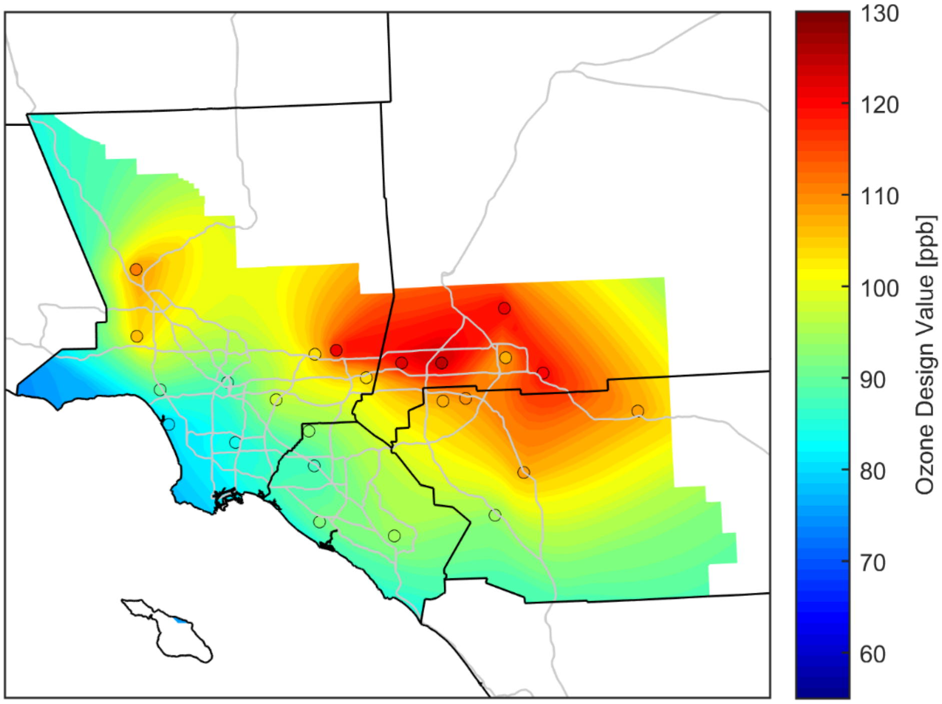

FIGURE 5-9

MODEL-PREDICTED 2022 BASELINE 1-HOUR OZONE CONCENTRATIONS (ppb)

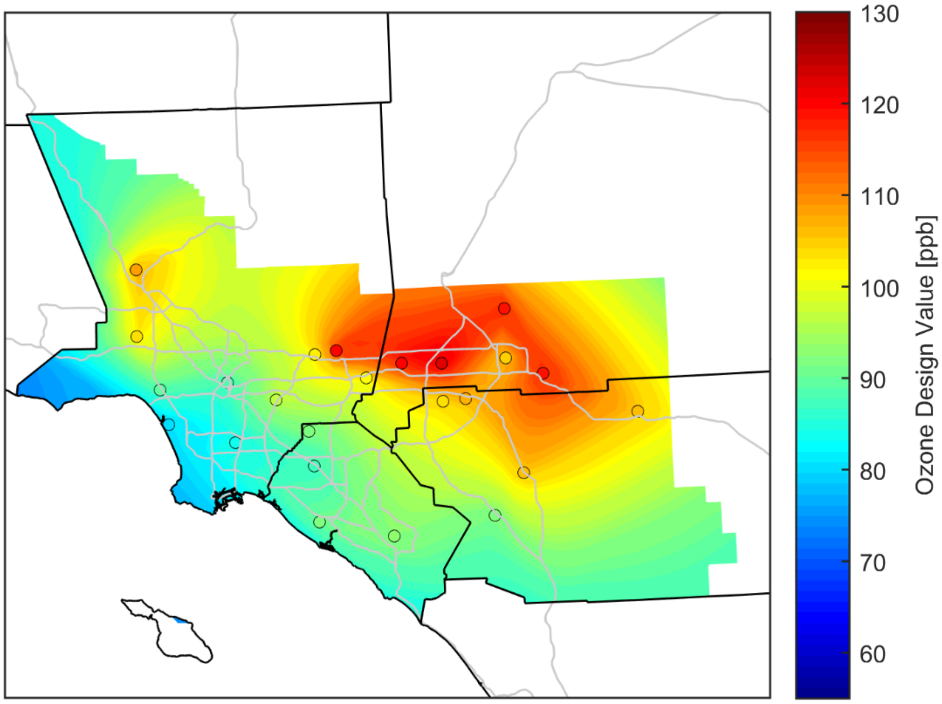

FIGURE 5-10

MODEL-PREDICTED 2022 CONTROLLED 1-HOUR OZONE CONCENTRATIONS (ppb)

Weight of Evidence

Ozone modeling guidance strongly recommends the use of corroborating evidence to support the future year attainment demonstration. The weight of evidence demonstration for the 2016 AQMP includes a model performance evaluation on the temporal profile of on-road mobile source emissions and spatial surrogate profiles of area source emissions. Detailed discussions of all model results and the weight of evidence discussion are provided in Appendix V.

PM2.5 Modeling Approach

Simulations for the PM2.5 concentrations were conducted for 2012 (base year), 2019 (24-hour PM2.5 attainment date), and 2025 (annual PM2.5 attainment date for "serious" nonattainment status). In addition, 2023 was included in the analysis to evaluate the co-benefits from the ozone control strategy.

Design Values and Relative Response Factors (RRF)

The 24-hour PM2.5 design value is determined from the three-year average of the 98th percentile of all 24-hour concentrations sampled at a monitoring site. The annual PM2.5 design value is based on the four quarterly average PM2.5 concentrations, averaged by year, for a three-year period.

Design Value Selection

U.S. EPA guidance recommends the use of multiple year averages of design values, where appropriate, to dampen the effects of single year anomalies to the air quality trend due to factors such as adverse or favorable meteorology or radical changes in the local emissions profile. The trend in the Basin 24-hour PM2.5 design values, determined from routine Federal Reference Method (FRM) samples from 1999 through 2014 (Figure 5-11), depicts large reductions in concentrations over the period. However, the rate of decrease in both annual and 24-hour design values has slowed or reversed in recent years. The 24-hour PM2.5 design value for 2001 was 76 $\mu g/m^3$ while the 2014 design value (based on data from 2012, 2013 and 2014) was 38 $\mu g/m^3$. The annual PM2.5 design value has demonstrated a reduction of 15.2 $\mu g/m^3$ over the period from 2001 through 2014. The slowing or reversal in the rate of PM2.5 reduction in recent years is largely due to the reduced atmospheric cleansing and mixing from the multi-year drought affecting the region. In the absence of this severe drought, it is anticipated that the Basin would be even closer to attaining both the annual and 24-hour PM2.5 standards, as projected in the previous AQMPs.

Consistent with U.S. EPA guidance, the 2016 AQMP relies on a five-year weighted annual average centered on 2012, the base year selected for the emissions inventory development, WRF simulations and the anchor year for the future year ozone and PM2.5 projections.

Table 5-4 provides the five-year weighted 2012 annual and 24-hour average PM2.5 design values for four Speciation Air Sampling System (SASS) sites – Anaheim, Fontana, Los Angeles and Riverside, as well as Mira Loma, the station with the highest PM2.5 design value in the Basin and the only station currently exceeding the 24-hour PM2.5 standard.

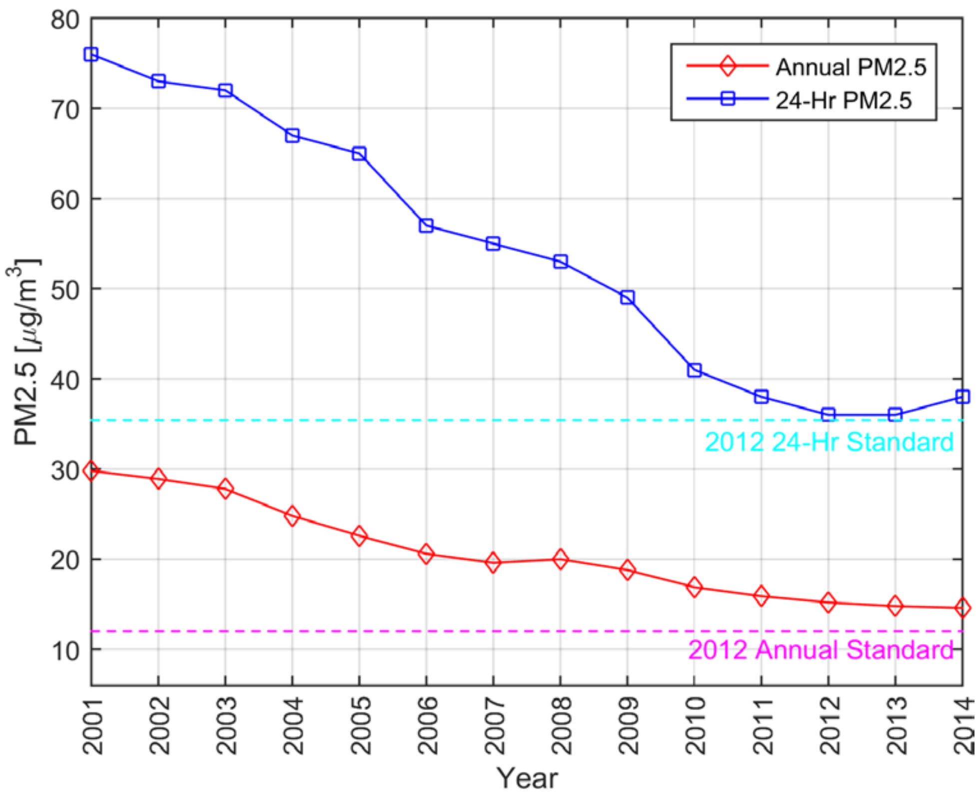

FIGURE 5-11

SOUTH COAST AIR BASIN ANNUAL PM2.5 AND 24-HOUR AVERAGE DESIGN VALUES.

TABLE 5-4

2012 Five-year Weighted PM2.5 Design Values (DV) (μg/m^3)

Monitoring Site	Annual DV	24-Hour DV
Anaheim	10.57	26.0
Fontana	12.60	32.7
Los Angeles	12.43	31.0
Mira Loma	14.87	36.7
Riverside Rubidoux	13.13	33.0

Calculated based on quarterly observed data between 2010 and 2014

PM2.5 Modeling

PM2.5 is either directly emitted into the atmosphere (primary particles), or formed through atmospheric chemical reactions from precursor gases (secondary particles). Primary PM2.5 includes road dust, diesel soot, combustion products, and other sources of fine particles. Secondary products, such as sulfates, nitrates, and complex organic carbon compounds are formed from reactions with oxides of sulfur, oxides of nitrogen, VOCs, and ammonia.

PM2.5 speciation data measured at four SASS sites during 2012 provided the chemical characterization for evaluation and validation of the CMAQ model predictions. With one site in each county, the four SASS sites are strategically located to represent aerosol characteristics in the four counties in the Basin. Riverside-Rubidoux was traditionally the Basin maximum location. Fontana and Anaheim experience high concentrations within their respective counties, and the Central Los Angeles site was intended to capture the characteristics of an emission source area. The close proximity of Mira Loma to Rubidoux and the common in-Basin air flow and transport patterns enable the use of the Rubidoux speciated data as representative of the particulate speciation at Mira Loma. Both sites are directly downwind of the dairy production areas in Chino and the warehouse distribution centers located in the northwestern corner of Riverside County. Speciated data monitored at the selected sites for MATES IV, which were conducted for the period of June 2012 to June 2013, were analyzed to corroborate the applicability of using the 2012 chemical profiles.

Model performance was evaluated against concentrations of ammonium, nitrates, sulfates, secondary organic matter, elemental carbon, primary and total mass of PM2.5 measured at the four monitoring sites (Rubidoux, Central Los Angeles, Anaheim, and Fontana).

The following section summarizes the PM2.5 modeling approach conducted in preparation for this Plan. Details of the PM2.5 modeling are presented in Appendix V.

Annual PM2.5 Modeling Approach

The 2016 AQMP annual PM2.5 modeling employs the same approach in estimating the future year annual PM2.5 levels as was described in the 2012 AQMP attainment demonstrations except for updates in the modeling platform, input databases and emissions inventory. Future year PM2.5 annual average air quality is determined using site- and species-specific quarterly-averaged RRFs applied to the weighted quarterly average 2012 PM2.5 design values per U.S. EPA guidance (U.S. EPA, 2014[2]).

CMAQ simulations were conducted for 366 days from January 1 to December 31 of 2012. The simulations included 8,784 consecutive hours from which daily 24-hour average PM2.5 concentrations were calculated. A set of RRFs were generated for each future year simulation. RRFs were generated for ammonium (NH4), nitrate (NO3), sulfate (SO4), organic carbon (OC), elemental carbon (EC), sea salts (Salt) and a combined grouping of crustal compounds and metals (Others). For each species, a total of 16 RRFs were generated for each future year simulation (four seasons and four monitoring sites). Future year design values were calculated by multiplying the species- and site-specific RRFs by the corresponding quarterly mean component concentration. The quarterly mean components were summed to get

[2] https://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

quarterly mean PM2.5 levels, which were then averaged to determine the annual design values (Table 5-5).

24-Hour PM2.5 Modeling Approach

The RRF approach requires two components: base year design values from measurement data and RRFs from model predictions per U.S. EPA guidance. The base year design value is established using the top 8 days in each quarter per year for the five-year period used in the weighted average (2010–2014). Details on the RRF approach for the 24-hour PM2.5 attainment demonstration are provided in Appendix V. Future year PM2.5 24-hour average concentrations are presented for the 2019 24-hour PM2.5 attainment deadline. The projection suggests that the 2019 baseline with no further controls will attain the standard, which is consistent with the results presented in the 2012 AQMP. In addition, Appendix V includes discussions for chemical speciation, an unmonitored area analysis, and an analyses of the potential impact of future drought conditions.

Future PM2.5 Air Quality

Annual PM2.5

Annual PM2.5 concentrations were simulated for the base year (2012) and future milestone years (2021 and 2025). For the future years, both baseline and control scenarios were included in the analysis. The results are presented in Table 5-5 and Figure 5-12. Mira Loma, the design site for the base year, has a five-year weighted design value of 14.9 $\mu g/m^3$ in 2012, in attainment of the previous 1997 standard (15 $\mu g/m^3$), but not the 2008 standard. Mira Loma is projected to remain as the highest PM2.5 site in 2025. The baseline cases, which do not include additional controls beyond already adopted measures, project future design values close to 12.3 $\mu g/m^3$ but are not low enough to meet the standard. Still, the future year concentrations are expected to be well below the previous 1997 standard. The control scenarios capturing SCAQMD stationary source PM2.5 measures in the 2016 AQMP were evaluated as well. However, it is practically challenging to implement the directly emitted PM reductions from the SCAQMD PM control measures by 2021 and, even if so, the emission reductions from those measures are not enough to achieve attainment in 2021.

Annual PM2.5 concentrations were further evaluated using emission reduction co-benefits from the ozone strategy for 2023. When all the NOx and VOC reductions proposed to attain the 80 ppb ozone standard are implemented in 2023, the PM2.5 annual design value for 2023 is expected to be 11.1 $\mu g/m^3$, demonstrating attainment of the annual standard two years in advance of the 2025 “serious” area deadline. However, the ozone strategy may include CAA Section 182(e)(5) measures that are allowed in the SIP for ozone “extreme” nonattainment areas, but not for PM2.5. Therefore, an attainment scenario using only the control measures anticipated to be approved without 182(e)(5) flexibility was developed for 2025. This scenario showed an annual PM2.5 design value of 12.0 $\mu g/m^3$ at the Mira Loma site, indicating that the annual PM2.5 standard is expected to be met by 2025 without additional measures directed specifically at PM reductions.

TABLE 5-5

Annual Average PM2.5 Design Concentrations (µg/m^3)

Station	2012	2025 Baseline	2025 Control	2023 O3 Attainment Scenario
Anaheim	10.6	9.3	9.1	8.7
Fontana	12.6	10.5	10.3	9.7
Los Angeles	12.4	10.8	10.4	9.7
Mira Loma	14.9	12.3	11.8	11.1
Rubidoux	13.2	10.9	10.6	9.9

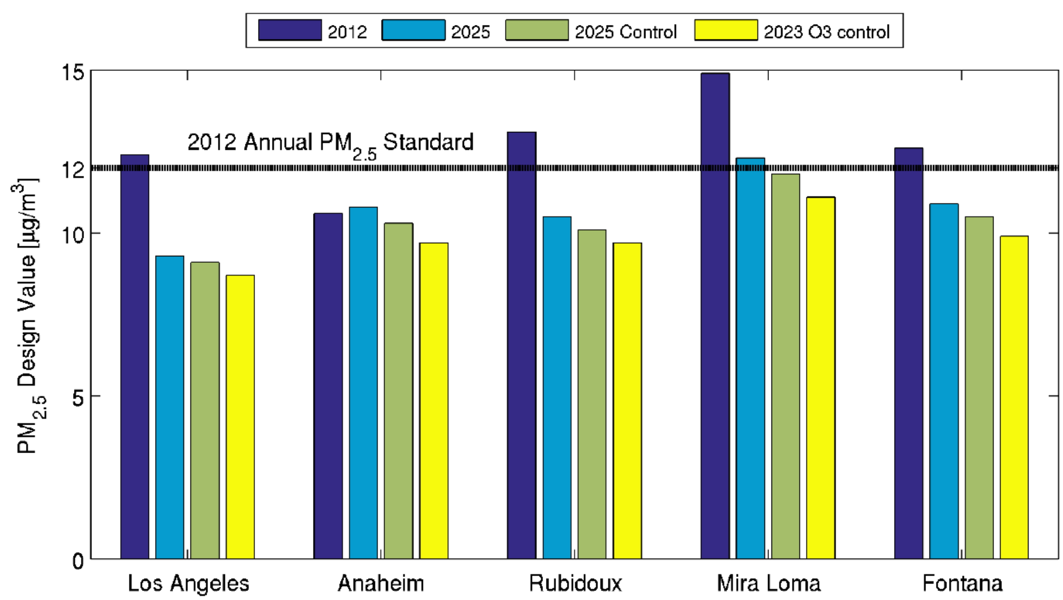

FIGURE 5-12

ANNUAL AVERAGE PM2.5 CONCENTRATIONS. FEDERAL STANDARD IS DENOTED WITH A HORIZONTAL GREY LINE

Spatial Projections of Annual PM2.5 Design Values

Figure 5-13 provides a perspective of the Basin-wide spatial extent of annual PM2.5 design values in the base year, 2012. Figure 5-14 shows the projected PM2.5 concentrations in 2023 with the full implementation of the ozone control strategy, but no additional control on directly emitted PM. The 2025 baseline case does not lead to attainment of the standard (Figure 5-15), but NOx and VOC reductions from non-182(e)(5) control measures are expected to lead to attainment as all the monitoring stations within the Basin exhibit annual PM2.5 levels below the federal standard of 12 μg/m^3 (Figure 5-16).

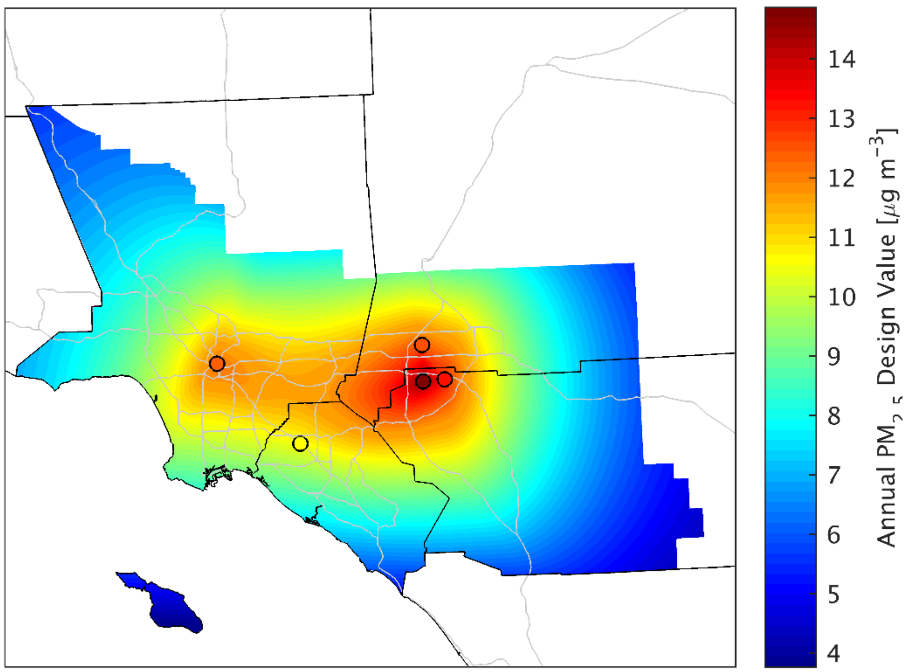

FIGURE 5-13

5-YEAR WEIGHTED ANNUAL PM2.5 DESIGN VALUES (μg/m^3) for 2012

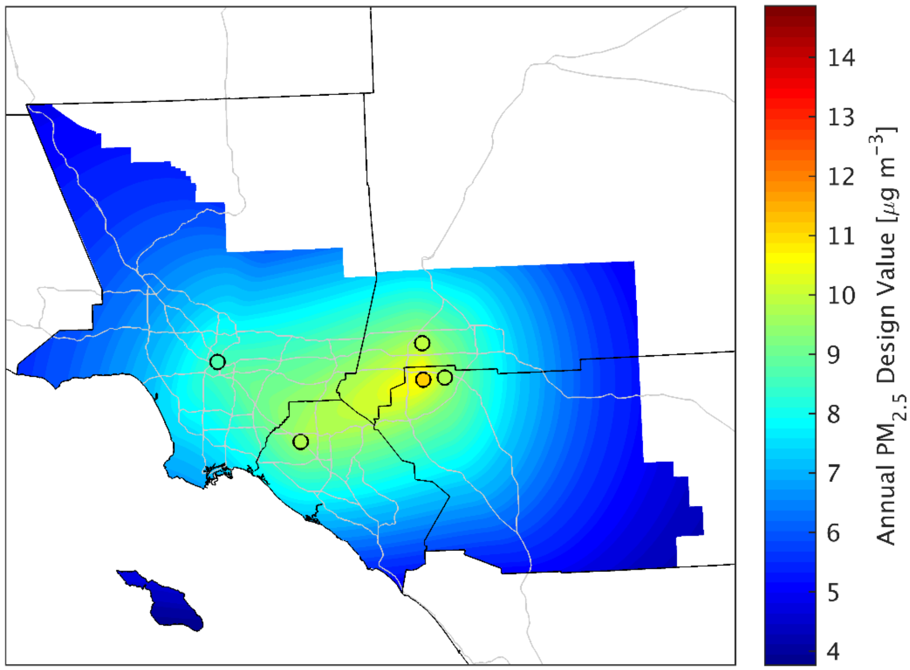

FIGURE 5-14

ANNUAL PM2.5 CONCENTRATIONS (μg/m^3) WITH 2023 8-HOUR OZONE ATTAINMENT SCENARIO

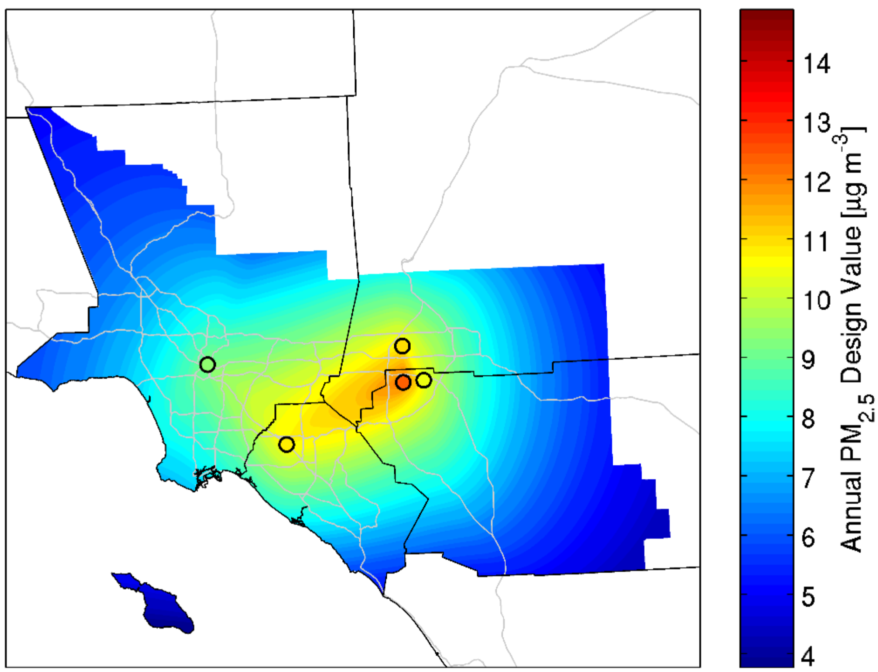

FIGURE 5-15

ANNUAL PM2.5 CONCENTRATIONS (μg/m^3) WITH 2025 BASELINE EMISSIONS

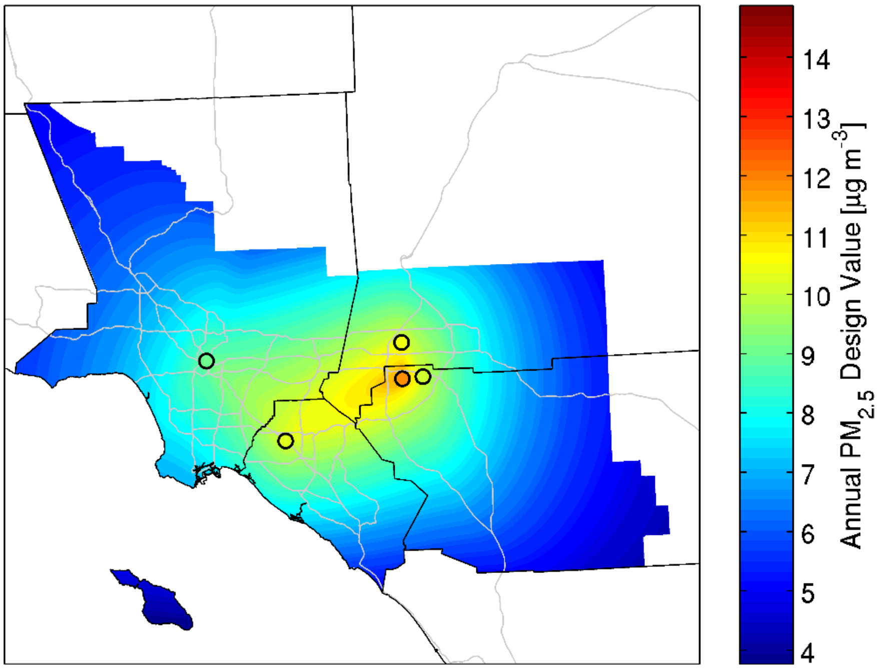

FIGURE 5-16

ANNUAL PM2.5 CONCENTRATIONS (µg/m^3) for 2025 ATTAINMENT SCENARIO

24-Hour PM2.5

A numerical simulation with 2019 baseline emissions was conducted to assess 24-hour PM2.5 attainment status in the Basin. Simulation of the 2019 baseline emissions indicates that the Basin will attain the federal 24-hour PM2.5 standard in 2019 without additional controls (See Table 5-6 and Figure 5-17). This is consistent with the findings of the 2012 AQMP, which demonstrated attainment in 2019 without any additional controls. The projected 2019 design value is 32.1 µg/m^3 at Mira Loma.

The level of 24-hour PM2.5 concentrations projected for 2019 is significantly lower than the standard (35 µg/m^3). While the District is committed to attain as expeditiously as practicable, unforeseen meteorological conditions such as drought or severe wild fire events would hinder the projected attainment. For example, the severe drought that prevailed from 2011 to 2015 delayed the attainment projected in the 2012 AQMP and the subsequent Supplement to the 2012 AQMP. However, the lower projected design value will help to ensure attainment even in the presence of unforeseen meteorological events. Detailed discussions of the impacts of the drought on PM2.5 are included in Appendix V.

TABLE 5-6

24-Hour Average 5-Year Weighted PM2.5 Concentrations (µg/m^3)

Station	2012 Base Year	2019 Baseline
Anaheim	25.8	23.5
Fontana	32.7	28.0
Los Angeles	30.5	27.6
Mira Loma	36.5	31.4
Rubidoux	33.2	28.3

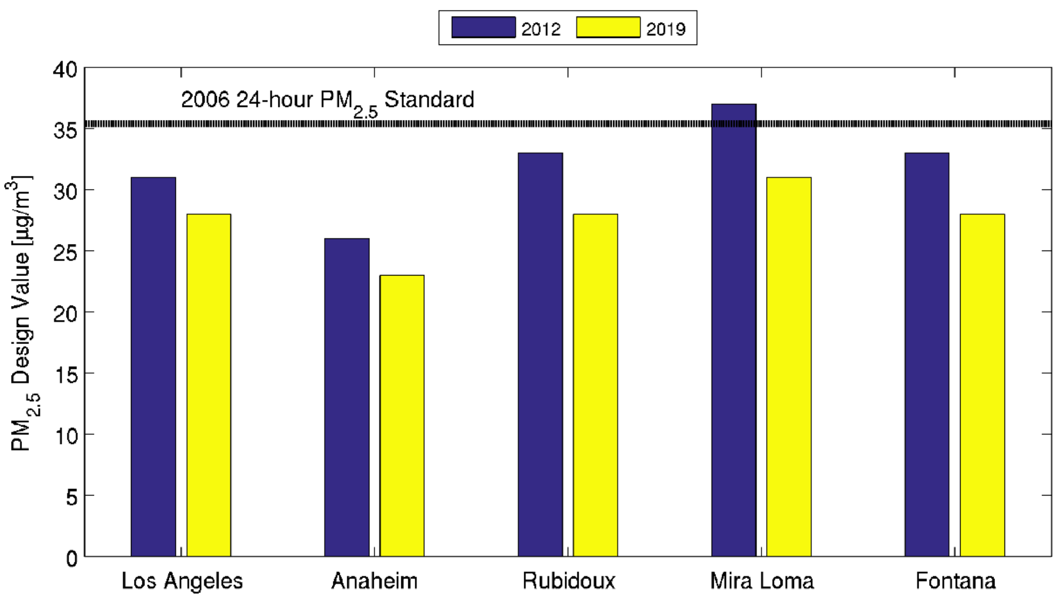

FIGURE 5-17

MAXIMUM 24-HOUR AVERAGE PM2.5 DESIGN CONCENTRATIONS: 2012 BASELINE AND 2019 BASELINE (NO ADDITIONAL CONTROLS).

Spatial Projections of 24-Hour PM2.5 Design Values

Figure 5-18 provides the Basin-wide spatial extent of 24-hour PM2.5 levels in the base year resulting from the interpolation of design values at the four speciation stations and Mira Loma. Several areas around the northwestern portion of Riverside and southwestern portion of San Bernardino Counties depict grid cells with weighted PM2.5 24-hour design values exceeding 35 μg/m^3 in 2012. Figure 5-19 shows an interpolated spatial representation of future model-predicted 24-hour design values in 2019. By 2019, Mira Loma, the PM2.5 24-hour design station, will attain the federal standard. The design values in other areas, determined by interpolation of the five stations, will also attain the federal standard.

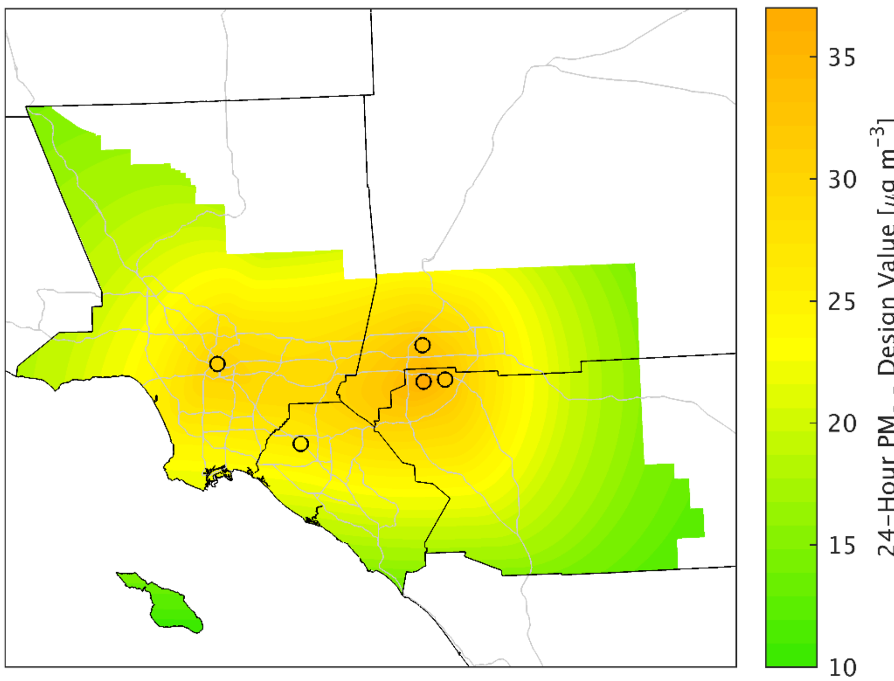

FIGURE 5-18

2012 BASELINE 24-HOUR PM2.5 CONCENTRATIONS (μg/m^3). COLORS CORRESPOND TO THE AIR QUALITY INDEX

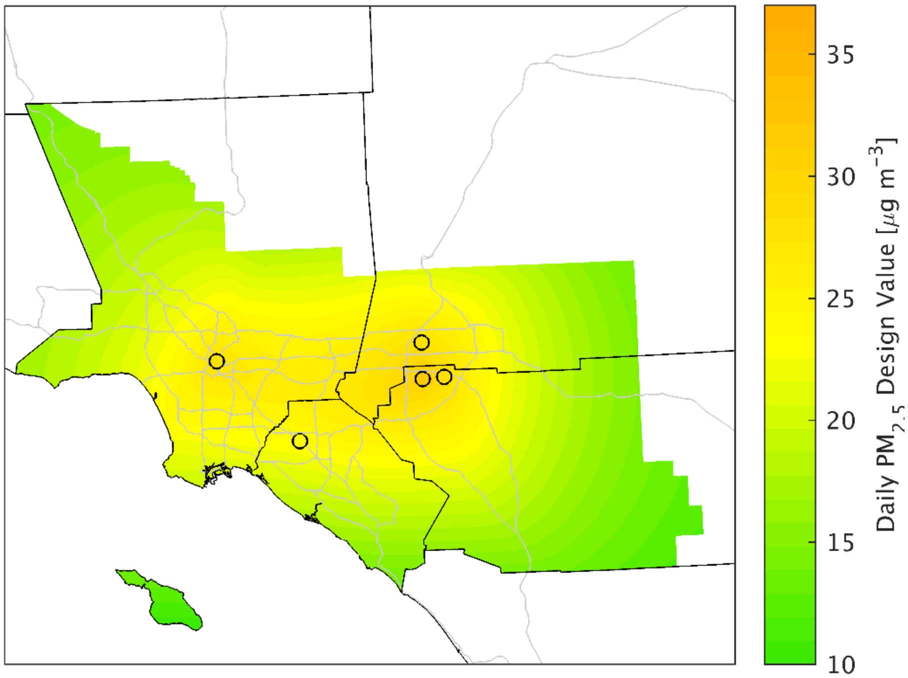

FIGURE 5-19

2019 24-HOUR PM2.5 CONCENTRATIONS (μg/m^3). COLORS CORRESPOND TO THE AIR QUALITY INDEX

Additional Modeling Analyses

A First Look at Attaining the 2015 8-Hour Ozone Standard

In 2015, the U.S. EPA lowered the federal 8-hour ozone standard to 70 ppb. Recent 8-hour ozone rule implementation guidance requires that a SIP revision with an updated attainment demonstration and control strategy be submitted to U.S. EPA no later than four years after designation. The Basin will likely be designated as an "extreme" nonattainment area for the new standard in 2017, consistent with the classification of the 75 ppb standard. Thus, the deadline for attainment of the 70 ppb standard is 20 years after designation (likely 2037), six years after the attainment deadline for the 75 ppb federal standard. It is critical to conduct preliminary analyses to assess the need for potential adjustments to the overall control strategy when considering this new standard and deadline.

The preliminary projections, based upon ozone "isopleths" developed for the 2031 emission scenarios indicate that 2037 Basin NOx carrying capacity to meet the 70 ppb standard could be as low as 75 TPD. This is additional 62 percent NOx reduction beyond the projected 2037 baseline and 25 TPD of additional NOx emission reductions between 2031 and 2037. Further discussion of the Basin's status relative to the new 2015 8-hour ozone standard is presented in Chapter 8.

Summary and Conclusions

Figure 5-20 shows the Basin-wide maximum 8-hour ozone concentrations in the base year (2012) along with projected design values for the attainment deadline of the 1997 standard of 80 ppb (2023) and for the 2008 standard of 75 ppb (2031). Figure 5-21 shows the same projected design values relative to the California standards. With the controls proposed in the 2016 AQMP, the future year ozone concentrations are expected to meet the federal standards. NOx reductions of approximately 45 percent and 55 percent from the baseline levels are needed in 2023 and 2031, respectively (Figure 5-22). Approximately 50 TPD of NOx and VOC combined reductions from the 2022 baseline are needed to meet the 1-hour ozone standard in 2022, confirming that the 8-hour standard is a more stringent form than the 1-hour standard. The strategies developed for attainment of the 2023 and 2031 8-hour standards will ensure attainment of the 1-hour standard in 2022 (Table 5-7).

The California standard for 8-hour ozone is 70 ppb, the same level as the 2015 revised federal standard. This state standard will not be achieved by 2031. Preliminary analysis suggests additional emission reductions beyond the level required in 2031 are needed to meet the 70 ppb standard. Challenges in achieving the 70 ppb standard are discussed in Chapter 8.

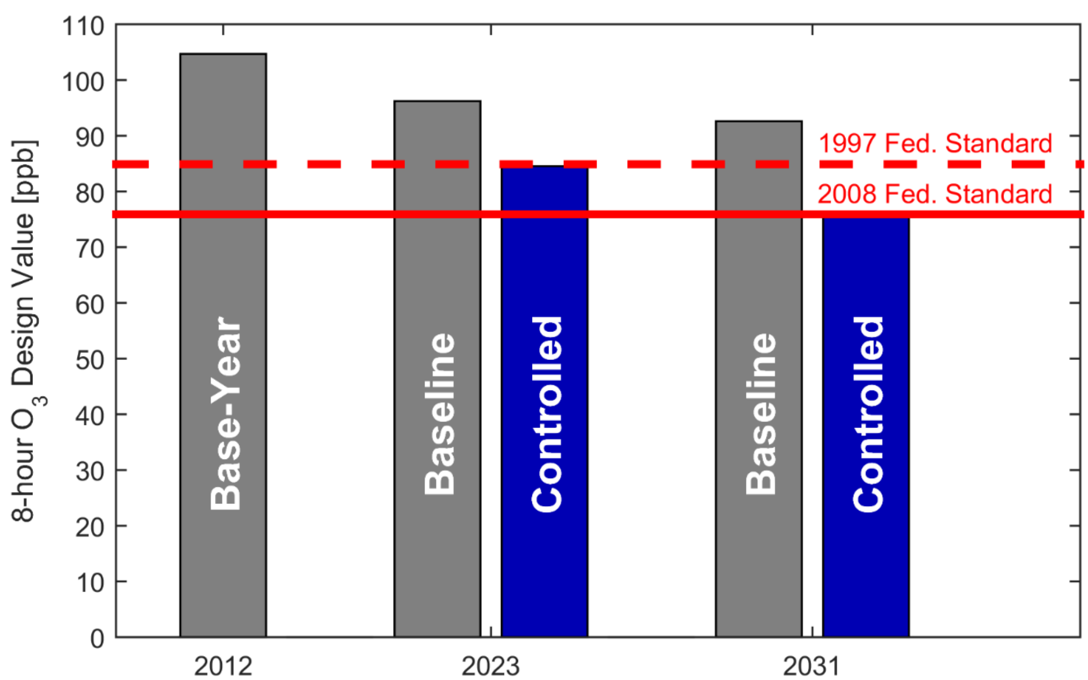

FIGURE 5-20

PROJECTION OF FUTURE 8-HOUR OZONE AIR QUALITY IN THE BASIN IN COMPARISON TO FEDERAL STANDARDS

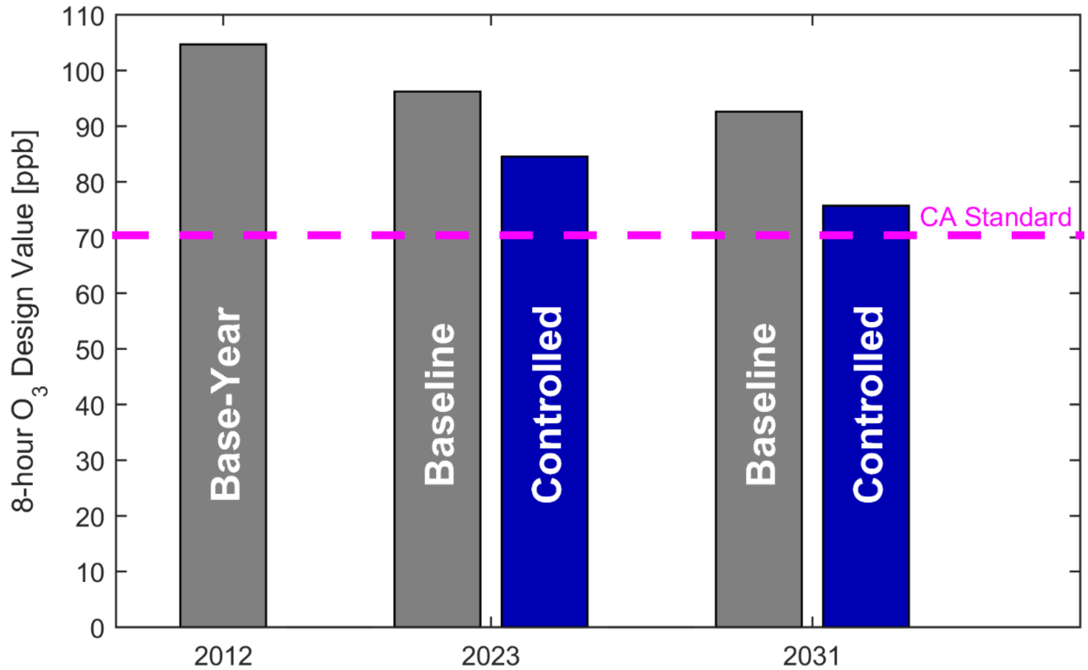

FIGURE 5-21

PROJECTION OF FUTURE 8-HOUR OZONE AIR QUALITY IN THE BASIN IN COMPARISON TO CALIFORNIA STANDARDS

TABLE 5-7

Basin NOx Carrying Capacity for Ozone Attainment

Attainment Year	2022	2023	2031
Federal Standard	1-hr Ozone (120 ppb)	8-hr Ozone (80 ppb)	8-hr Ozone (75 ppb)
NOx Carrying Capacity (TPD)	245*	141	96

*The reductions needed to attain the 1-hour standard can be achieved from either NOx or VOC emissions.

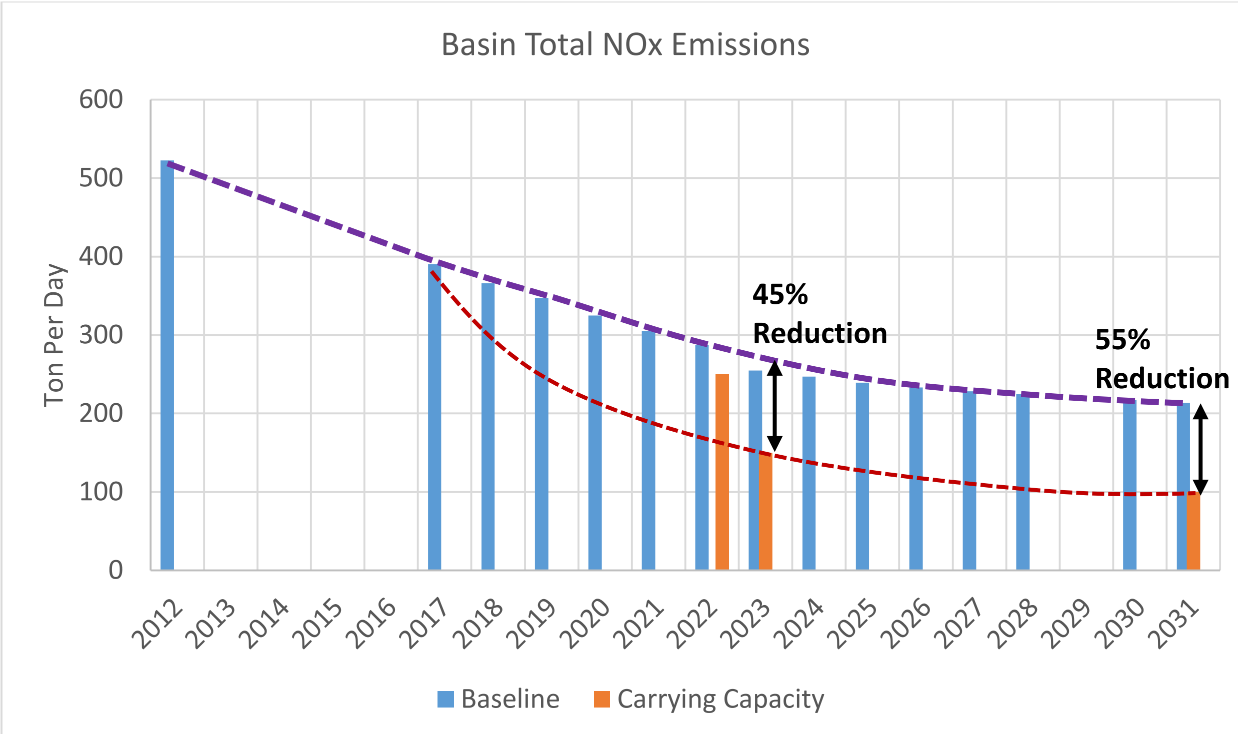

FIGURE 5-22

SUMMER PLANNING BASELINE EMISSIONS AND OZONE CARRYING CAPACITY

Figure 5-23 shows the 2012 observed base-year design value along with the2023 and 2025 model-predicted future design values of annual PM2.5. The federal annual PM2.5 standards are predicted to be achieved in 2023 with implementation of the proposed ozone strategy. However, the federal CAA does not allow 182(e)(5) measures in the attainment demonstration of PM2.5; therefore, an additional scenario using only non-182(e)(5) measures was developed for 2025 to comply with the CAA requirements. With only the non-182(e)(5) measure reductions, the annual PM2.5 standard is expected to be met in 2025.

Table 5-8 presents the future Basin annual PM2.5 design values under each control scenario. Table 5-8 also contains the predicted 2025 design value resulting from the ozone control strategy in the absence of 182(e)(5) measures. Attainment is achieved in 2025 under this scenario.

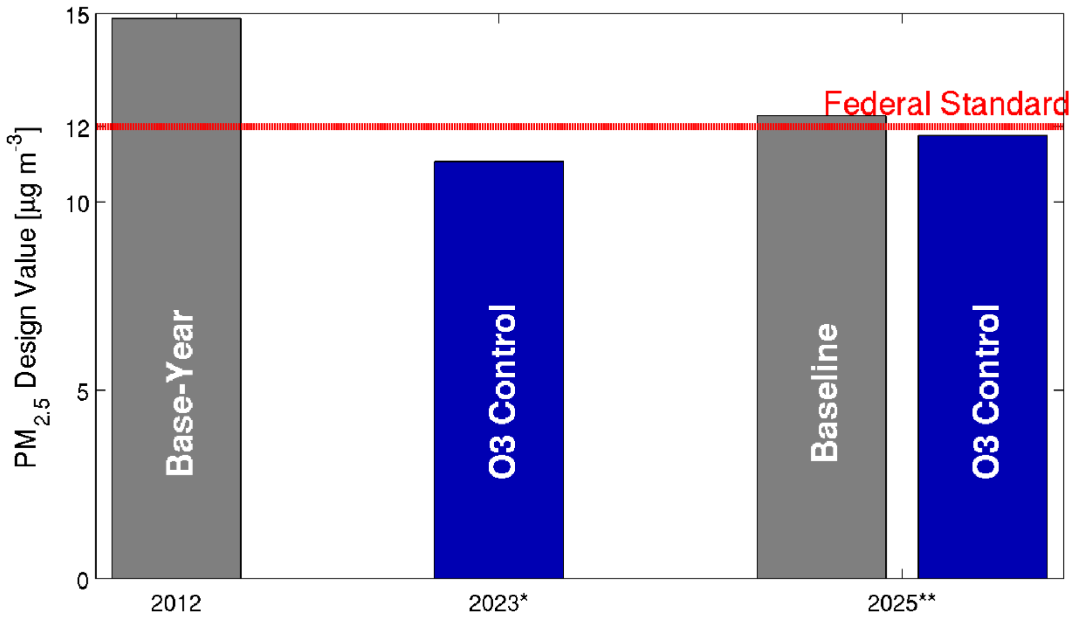

FIGURE 5-23

PROJECTION OF FUTURE ANNUAL PM2.5 AIR QUALITY IN THE BASIN IN COMPARISON WITH FEDERAL STANDARDS

*INCLUDES 182(E)(5) MEASURES
**DOES NOT INCLUDE 182(E)(5) MEASURES

TABLE 5-8

Future Design Values of Annual Average PM2.5 at Mira Loma in µg/m^3

Station	Baseline	Controlled	Control Strategy
2023	12.1	11.1	Ozone co-benefit including 182(e)(5) measures
2025	12.3	11.8	Ozone co-benefit without 182(e)(5) measures